DOCUMENT RESUME

ED 445 898 SE 063 876

AUTHOR Buchner, P.
TITLE Interactions between the German and Anglo-American Systems in Electrical Engineering Education.
PUB DATE 1998-08-20
NOTE 7p.
PUB TYPE Guides - Classroom - Teacher (052)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Economics; *Engineering Education; Foreign Students; Futures (of Society); Higher Education; Scholarships; *Study Abroad; Undergraduate Study
IDENTIFIERS *Germany

ABSTRACT

Current trends in engineering education must accommodate the fast development of the global industrial marketplace. The well-known inertia against change in institutions of higher education will not fit for the foreseeable future. The career paths of our engineering graduates have changed and will change further, when industry moves to global playing, communications and information technology push the economy and the change from a manufacturing based economy to a more service-oriented economy is developing. The development of better international interfaces among the evermore distinct national education systems is of an increasing importance for a modern society. In Germany a number of technical universities financially supported by the German Academic Exchange Service (Deutscher Akademischer Austauschdienst - DAAD) have started new programs to attract more foreign students and graduates especially in technical fields. This paper gives a survey of the current situation from the perspective of the German Assembly of Electrical Engineering Departments (Deutscher Fakultatentag fur Elektrotechnik - DFTE) and describes the actions taken by one member, the Dresden University of Technology. (Author)

Reproductions supplied by EDRS are the best that can be made
from the original document.

ED 445 898

Interactions Between The German And Anglo-American Systems In Electrical Engineering Education

P. Buchner
Fakultät Elektrotechnik
Technische Universität Dresden
Mommsenstraße 13, D 01062 Dresden, Germany
E-mail: buechner@eeisz1.et.tu-dresden.de

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.
Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Abstract *- Current trends in engineering education must accommodate the fast development of the global industrial marketplace. The well-known inertia against change in institutions of higher education will not fit for the foreseeable future. The career paths of our engineering graduates have changed and will change further, when industry moves to global playing, communications and information technology push the economy and the change from a manufacturing based economy to a more service-oriented economy is developing. The development of better international interfaces among the evermore distinct national education systems is of an increasing importance for a modern society. In Germany a number of technical universities financially supported by the German Academic Exchange Service (Deutscher Akademischer Austauschdienst - DAAD) have started new programs to attract more foreign students and graduates especially in technical fields. This paper gives a survey of the current situation from the perspective of the German Assembly of Electrical Engineering Departments (Deutscher Fakultatentag fur Elektrotechnik - DFTE) and describes the actions taken by one member, the Dresden University of Technology.*

Introduction

The percentage of students studying abroad for longer periods either in other European countries (sponsored by the ERASMUS/SOCRATES programs of the European Community (EC)) or especially in USA (IAS (integrated studies abroad) programs of the DAAD) has been increased during the last decades. Since 1990 students from East European and the former East German universities are actively participating in these study abroad programs. Not only the interest of German students to study foreign languages and cultures, and to visit well-known places of research and academic institutions explains this trend, but also the students awareness that this type of foreign experience will better qualify them for the global engineering market. The industry is interested in highly qualified and flexible engineers familiar with team-work. Another reason is the shifting of the centers of production and the market for products of electrical engineering to places outside of Europe.

While German students increasingly leave to study abroad, on the other hand the number of foreign students studying Electrical Engineering (EE) in Germany at the end of the nineties is lower than in the years before. In the seventies, German universities were the first choice for students from Asia and South America, where now the young generation prefers a study in Japan, USA or even Australia. For several years the German industry and the government have analyzed this situation. As one reason for this situation the lack of sufficient interfaces to other EE education systems was detected. To reverse this trend several new undergraduate and graduate programs have been established during the last two years. The following different programs are analyzed below:

- Pilot Undergraduate Degree Project of the DFTE (B.Sc. in EE) in German
- DAAD Undergraduate Degree Program in English
- DAAD Bachelor-Master Program (Postgraduate Degree Program in two languages)
- DAAD Integrated Courses in English (Auslandsorientierter Studiengang - AS)

The German System Of Engineering Education

To understand the need for special interfaces information of the German system of Electrical Engineering education (EEE) - including the fields of Electronics, Microelectronics and Communications Engineering - should be summarized. In Germany EEE is nowadays organized in three different types of institutions, where all three final degrees use the same term „Dipl.-Ing." with only an addendum in brackets. This raises sometimes confusion in foreign countries.

In a Professional College (Berufsakademie (BA)), students take their EEE in close combination with practical work in a company during three years at highly specialized fields. The industrial application of technical knowledge is the aim of this type of EEE. The degree Dipl-Ing. (BA) is the lowest level of an engineering-degree in Germany. The next level is the Dipl.-Ing. (FH), the result of a four years study in a Technical College (Fachhochschule (FH)). The highest degree in EEE is the Dipl.-Ing. of a University, which can be awarded after a five years study from 32

BEST COPY AVAILABLE

universities in Germany. The comparability and quality of this degree is ensured by the 28 members of the DFTE. The differentiation into a more theoretical-oriented scientific engineering education and a more application-oriented scientific education has a long tradition in Germany and is well-accepted by the German industry.

The German doctorate (Dr.-Ing.) can be awarded, normally, after having completed a three to four year research project at a university, or sometimes in cooperation with industrial research laboratories, if a university professor accepts the candidate. The awarding of the Dr.-Ing. degree to persons holding the Dipl.-Ing. or M. Sc. from a university is a traditional privilege of the universities. Currently a special procedure has been established for high level Dipl.-Ing.(FH) graduates with a good academic record to earn the doctors degree from a university. The procedure includes means to complement the theoretical background of the candidate as well as the cooperation with professors from the FH as competent persons in the academic qualification procedure. During the last years several special doctorate courses (Graduiertenkollegs) with a duration of three years under the sponsorship of the German Research Foundation (DFG) have been installed in many universities. Figure 1 compares the time duration of the three different branches of the German EEE system.

Advantages Of The System

The German degree „Dipl.-Ing." has a long tradition and a good world-wide reputation combined with the accepted level of the German industry. A comparable EEE system is installed in many European countries. The basic idea of the system is shown in Figure 2a. In this diagram the intensity of the curricula work is drawn over an axis where, to the left, the more theoretical requirements are represented relative to more practical requirements on the right [1]. The area under the curves illustrates the different philosophies of the alternatives: University, FH and BA education. The main advantages of this system can be listed as follows:

- In the five years Dipl.-Ing. program of universities during the first two years a broad and deep scientific basic course covers in depth: mathematics, physics, EE, computer science and engineering basics. At the end of the basic course the success of learning is evaluated by an exhaustive mid-carrier test, the „Vordiplom", without any specialization.
- During the main study (the following three years), students specialize into several branches. The students must get through a number of compulsory fields expanded by electives. This offers the chance of the acquisition of their special job description. Finally, the Diploma-thesis („Diplomarbeit"), with a duration between six and nine months encourages students to work directly in a modern research field. A practical training in industry for 26 weeks belongs to this part of study, too.
- In principle, because from the BA and FH enough application-oriented engineers graduate in a shorter time than in the university program, an additional short-term study at the universities, comparable to the B.Sc., does not seem to be necessary. New degrees would only enlarge the variety of degrees offerings.
- Individual interfaces between the different EEE systems in Germany and other countries are already in place at universities today. Unfortunately, there are occasional difficulties in their use and often a lack of knowledge referring the prerequisites for an exchange.

Therefore some new ideas of the installation of interfaces to other national EEE systems have been created by the DFTE and will be described as follows. They

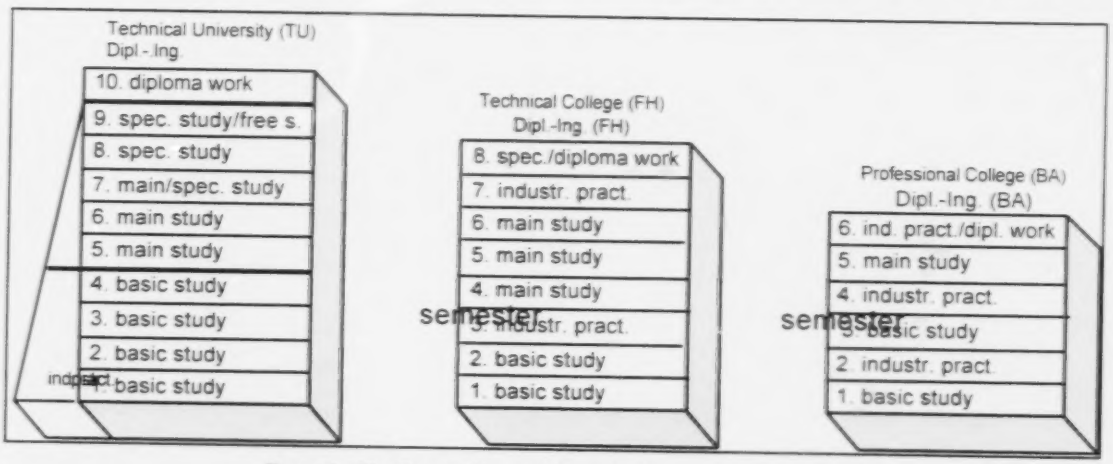

Figure 1. The German System of Electrical Engineering education

BEST COPY AVAILABLE

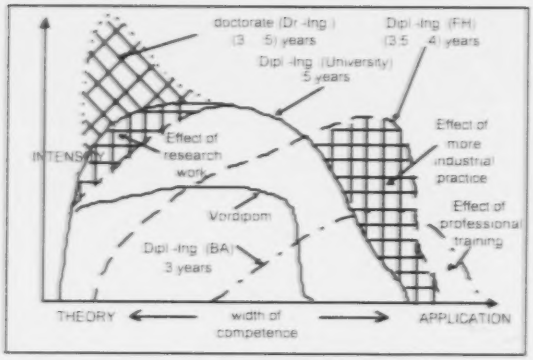

Figure 2a. Profile of intensity versus competence of different German degrees „Dipl.-Ing."

started with the world-wide comparison of the German

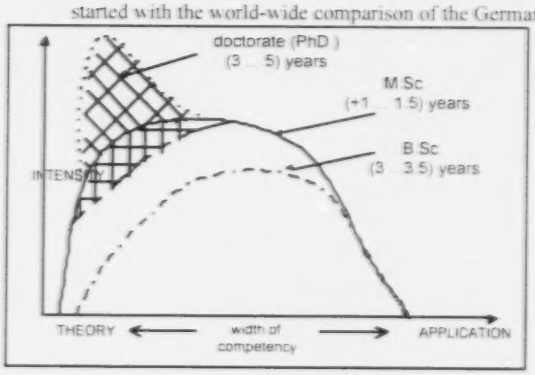

Figure 2b. Profile of intensity versus competence of the Anglo-American degrees B.Sc./M.Sc.

system with the variety of the Anglo-American sys-

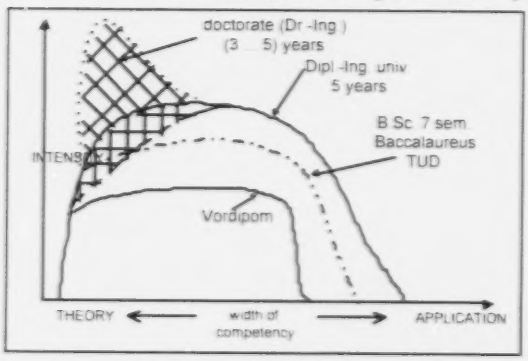

Figure 2c. Profile of intensity versus competence of the German Baccalaureus B.Sc.

tems. In Figures 2a and 2b the typical difference between the degrees is shown qualitatively. To correspond to the tendency of the global industry to hire young engineers with an excellent long-live theoretical knowledge, the competence to perform modern methods in their field and the ability of life-long learning was the reason to invent the German degree Baccalaureus B.Sc. as a combination of the „Vordiplom" with only three semesters of a more methodical-oriented and less differentiated main study. Figure 2c shows the idea which is realized in a pilot project e.g. at the Dresden University of Technology (TUD). This pilot project has been the fundament for a better definition of interfaces to the Anglo-American System.

Interfaces To The Anglo-American System (X-Model)

The following part describes the intentions of a so-called X-model published from the DFTE and used in a pilot project in the Departments of Mechanical Engineering and Electrical Engineering at the Dresden University of Technology starting with the academic year 1997/98. Figure 3 gives a graphical illustration of this model. The main idea is to use the well-established diploma-system of the German universities for offering a new exit with the degree „Bachelor of Science" after seven semesters mainly for foreign students who want to leave Germany with only that first academic degree of the Anglo-American EEE system. Additionally some German students, interested in pursuing a M.Sc. degree in the consecutive system e.g. in UK or USA will take part. Another point of importance may be the shifting of students with a B.Sc. in EE to MBA-programs in Germany or abroad to earn competence in management and business administration.

On the other hand this exit can be authorized by the German government, and the universities are then allowed to award the university degrees „Dipl.-Ing." or „M.Sc." alternatively. This will avoid some problems for German students, especially in USA, where often the German diploma degree is accepted only as a first degree.

The DFTE is convinced that the scientific level of the new B.Sc. is comparable in quality with the well established degrees in UK, USA and other countries and the German „Dipl.-Ing." is comparable to the M.Sc. degree. Students intending to obtain the B.Sc. will be enrolled in the ordinary diploma line of study. The decision whether ore not to go into the B.Sc. branch will be delayed until the fourth semester. The change from the B.Sc. branch into the diploma branch is allowed but not a change in the reverse direction. The B.Sc. branch offered in Dresden has only two fields of specialization: Information- & Microelectronics, Electrical Power Engineering & Electromechanics. The degree B.Sc. in Electrical Engineering will be awarded after the pre-diploma examination (basic study of 102 SWS), complemented with 10 subject grades and three achievement proofs during the main study (67 SWS), 14 weeks of industrial practice and a successful research project with a volume of 450 hours. (SWS stands for hours per week during one semester (credits), 15 weeks each). The ordinary di-

BEST COPY AVAILABLE

ploma line of study consists of additional 18 SWS, the diploma thesis (6 months) and 12 more weeks of industrial practice (26 weeks altogether).

Additionally this model offers a clearer described point of input for Bachelors from abroad into the German EEE system. The DAAD supports the abovementioned Bachelor-Master-Programs with funds for scholarships and funds for tutors. One of these programs was given to the Dresden University and is in preparation for launch during the academic year 1998/99 [2]. Incoming students will normally follow a four semester curriculum, where three semesters are reserved for lectures equivalent to the German Main Study with compulsory and optional lectures. The master thesis project will be selected during the fourth semester (six months). Depending on the individual needs and accomplishments (B.Sc., B.Eng. hons. etc.), students will get an individual curriculum, where in some cases a preparatory semester of remedial classwork is recommended for applicants who lack sufficient knowledge in German language. For all the other applicants only a one month crash course in German is offered directly before the beginning of the first semester. The language of the course is mainly German. Only some special lectures during the specialization are offered in English.

Another program funded by the DAAD is the program „foreign-oriented studies" (Auslandsorientierte Studiengänge (AS)), where the major part of the lectures is given in a foreign language (English or French) and lectures in German can be attended additionally. This program contains undergraduate (B.Sc.) as well as graduate courses (M.Sc.). Such bilingual studies include more than one university and exist together with France and Sweden. Such programs will be offered more and more frequently within the European Community (EC) [3].

Table 1 shows the current state of the DAAD-programs installed in German EE departments. The number of participants will be increasing during the next months and some FH take part yet. The most current information can be found on the homepages of the DAAD [3] and those of the different participating universities (WWW.{name of the university}.de).

For a small number of excellent students, supplementary courses are offered in parallel to the ordinary study. In Dresden e.g. this concerns courses in East-Asia sciences (The students learn the Chinese, Japanese or Korean language, study the culture of the region and absolve their industrial practice in the foreign country), in electric traction (together with the special department of transportation sciences) and technology of perfusion (in biomedical engineering).

Conclusions

Experiences gained abroad as well as knowledge of foreign languages and cultures are exceptionally important features for electrical engineers of today. The percentage of students combining their study with one or more semesters abroad has increased (e.g. in Dresden now to about 30% of a single age group). On the other hand the number of foreign students in Dresden has declined since the eighties.

BEST COPY AVAILABLE

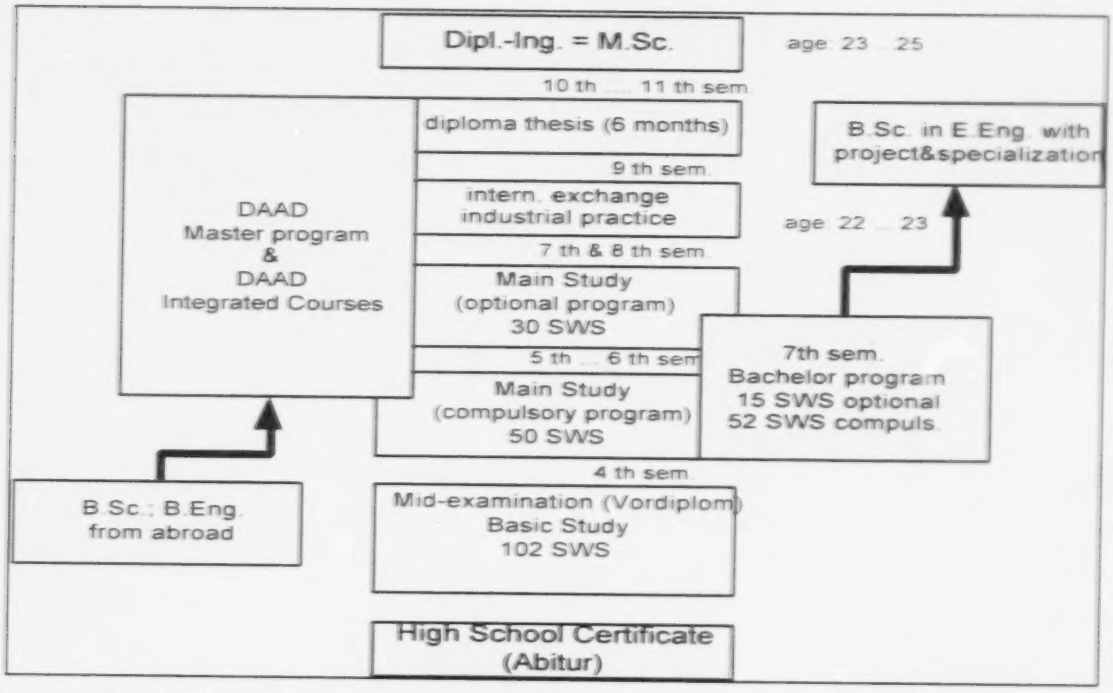

Figure 3. Illustration of the X-Model for interactions between German and Anglo-American EEE systems

The improvement of the interactions among the different EEE systems should lead to a better mutual understanding of the different contributions made in higher engineering education. It allows the students a greater flexibility in moving between different programs during their studies. The exchange programs of the EC and national programs of the DAAD together with the tuition-less study in Germany will be the basis for the further growth of the percentage of exchange. The German industry supports such programs through offers in industrial practice and funding through scholarships.

Our hope is that the installation of the X-model in some German universities will offer variants of pathways for such an exchange. The German EE departments and the DFTE will carefully monitor the quality of such programs.

Table 1. German Universities with DAAD-courses (current state April 1998)
(M) - M.Sc., (AS) - foreign oriented, (B) - B.Sc.

University name of the course - program	output B.Sc.	 M.Sc.	begin 1997	 1998	language En	 Ge
RWTH Aachen						
Electrical Power Engineering - DAAD (M)		X		X	(X)	X
TU Dresden						
Electrical Engineering - pilot project (B)	X		X			X
Electrical Engineering - DAAD (M)		X		X	(X)	X
Computational Logic - DAAD (AS)	X	X	X		X	
Universität-GH Duisburg						
Information Technology and Communication Engineering - DAAD (AS)	X	X	X		X	
TU Hamburg-Harburg						
Mechatronics - DAAD (M)		X	X		X	
Information and Communications Systems - DAAD (M)		X	X		X	
General Engineering Studies - DAAD (B)	X		X		X	
Universität Kaiserslautern						

BEST COPY AVAILABLE

Electrical Engineering - DAAD (M)		x		x	(x)	x
Universität Karlsruhe Electrical Engineering - DAAD (M)		x	x		(x)	x
Universität-GH Kassel Electrical Engineering/ Communications Engineering - DAAD (M)		x	x		(x)	x
Universität - GH Paderborn Electronic Engineering - DAAD (M)		x		x	(x)	x
Universität Ulm Communications Technology - DAAD (M)		x		x	(x)	x

The European Community should take the initiative of setting basic standards in higher engineering education and should install a European Accreditation System without the undesirable side-effect of complete uniformity. Knowledge about the course content, the advantages and disadvantages of the many different degrees throughout Europe and the world combined with a better compatibility of the degrees will lead to more competition among the universities, more exchange, to better understanding and, hopefully at the end, to faster growing economies [4]. It is of great importance, that such standards can be influenced commonly by the related faculties together with engineers from industry and not only by the authorities of higher education. The DFTE has installed a special working group dealing with evaluation of its members and accreditation of the EEE.

References

[1] Freise, W.: Die Ungleichartigkeit von Fachhochschule
und Universitäten, DHV-Stellungnahme.
MittHV (1989), Heft 5, S. 249.

[2] WWW-Homepage of the Dresden University
of Technology, Department of Electrical Engineering:
http://WWW.et.tu-dresden.de/ET_en.html.

[3] WWW-Homepage of the German Academic Exchange
Service http://WWW.daad.de.

[4] Lespinard, G. M.: Towards an European Accreditation
System in Engineering Education?
Aachen: Workshop on International Standards in EEE,
October 1996

BEST COPY AVAILABLE